Docket No. 62121 (70904)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	K. Okada et al.	CONF. NO.:	7788
U.S. SERIAL NO:	10/509,538	EXAMINER:	J. McPherson
FILED:	September 28, 2004	GROUP:	1756
FOR:	MICRO-LENS ARRAY SUBSTRATE AND PRODUCTION METHOD THEREFOR, AND PROJECTION TYPE LIQUID CRYSTAL DISPLAY USING THOSE		

Commissioner for Patents
P.O. Box 1450
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Sir:

AMENDMENT

Applicants are in receipt of the Office Action dated January 24, 2007 of the above-referenced application. Please amend the application as follows:

Amendments to the claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks begin on page 10 of this paper.

Amendments to the claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of claims:

Claim 1 (withdrawn): A micro-lens array substrate comprising first and second micro-lens arrays respectively having a plurality of lenses, wherein:

said first micro-lens array is sandwiched between two inorganic dielectric substrates; and

said second micro-lens array is formed on either one of said two inorganic dielectric substrates.

Claim 2 (withdrawn): The micro-lens array substrate as set forth in claim 1 wherein the first micro-lens array and the second micro-lens array are made from a layer of resin whose refractive index is different from a refractive index of the inorganic dielectric substrates.

Claim 3 (withdrawn): The micro-lens array substrate as set forth in claim 1 or 2, wherein the second micro-lens array is a stack of two or more layers of resin whose respective refractive indexes are different from one another.

Claim 4 (withdrawn): The micro-lens array substrate as set forth in claims 1 or 2, wherein the second micro-lens array is made of ultraviolet curable resin.

Claim 5 (currently amended): A production method of a micro-lens array substrate, comprising the steps of:

forming on an inorganic dielectric substrate a first micro-lens array with a plurality of lenses;

applying a photosensitive resin on the first micro-lens array;

patterning the photosensitive resin by irradiation of ultraviolet light or visible light; and

forming a second micro-lens array using the patterned photosensitive resin as a mask,

said step of patterning the photosensitive resin being ~~carried out using~~a step of forming the photosensitive resin into a required shape by adjusting a distribution of exposure light in the photosensitive resin by use of a beam that has transmitted through the first micro-lens array.

Claim 6 (original): The production method of a micro-lens array substrate as set forth in claim 5, wherein:

a middle layer made of an inorganic dielectric material is formed on the first micro-lens array substrate, and

the photosensitive resin, which is formed on the middle layer, is patterned by irradiation of visible light or ultraviolet light through the first micro-lens array and the middle layer, so as to form the second micro-lens array.

Claim 7 (original): The production method of a micro-lens array substrate as set forth in claim 6, wherein the first micro-lens array is set to have a focal plane in the vicinity of the photosensitive resin formed on the middle layer.

Claim 8 (currently amended): The production method of a micro-lens array substrate as set forth in ~~any one of claims 5 through 7~~claim 6 or 7, wherein:

a negative resist layer is used as the photosensitive resin;

the negative resist layer is patterned by irradiation of the beam that has transmitted through the first micro-lens array; and

etching is carried out on the negative resist layer so as to transfer a patterned shape of the negative resist layer to the ~~inorganic dielectric substrate~~middle layer.

Claim 9 (original): The production method of a micro-lens array substrate as set forth in any one of claims 5 through 7, wherein:

the photosensitive resin formed on the inorganic dielectric substrate has a two-layer structure of a first photosensitive resin and a second photosensitive resin, and

said production method further comprises the steps of:

applying and curing a visible light curable resin or an ultraviolet curable resin as said first photosensitive resin on the inorganic dielectric substrate; and

applying a negative resist as the second photosensitive resin, and wherein:

the second photosensitive resin is patterned into the second micro-lens array; and

the second micro-lens array is etched to transfer the pattern of the second micro-lens array to the first micro-lens array.

Claim 10 (original): The production method of a micro-lens array substrate as set forth in any one of claims 5 through 7, wherein:

an ultraviolet curable resin is used as the photosensitive resin formed on the inorganic dielectric substrate, and

the second micro-lens array is formed by:

curing the ultraviolet curable resin by irradiation of the beam that has transmitted through the first micro-lens array, and

removing uncured portions of the ultraviolet curable resin with an organic solvent.

Claim 11 (previously presented): The production method of a micro-lens array substrate as set forth in any one of claims 5 through 7, wherein:

the first micro-lens array is irradiated with a parallel ray with a uniform intensity distribution; and

patterning of the second micro-lens array is carried out with the micro-lens array substrate tilted with respect to an optical axis of the parallel ray.

Claim 12 (previously presented): The production method of a micro-lens array substrate as set forth in any one of claims 5 through 7,

wherein patterning of the second micro-lens array is carried out using an irradiated light image formed by irradiating the first micro-lens array with irradiated light whose intensity distribution has been determined by a transmittance modulation mask whose transmittance is continuously modulated.

Claim 13 (withdrawn): A projection liquid crystal display device comprising:

a white beam source;

beam splitting means for splitting a white beam from said white beam source into a plurality of beams of different wavelength bands;

a liquid crystal element, which is irradiated with the beams split by said beam splitting means; and

projection means for projecting a plurality of beams modulated through said liquid crystal display element,

said liquid crystal display element having a first micro-lens array and a second micro-lens array on a side closer to said white beam source, and

said second micro-lens array having a lens shape patterned by beams that have transmitted through said first micro-lens array.

Claim 14 (withdrawn): A projection liquid crystal display device comprising:

a white beam source; and

a liquid crystal display element, which is irradiated with a plurality of beams of different wavelength bands produced by splitting white-light from said white beam source,

said liquid crystal display element having a first micro-lens array and a second micro-lens array on a side closer to said white beam source, and

said second micro-lens array having a lens shape patterned by beams that have transmitted through said first micro-lens array.

Claim 15 (withdrawn): A micro-lens array substrate comprising a first micro-lens array having a plurality of lenses, wherein:

said first micro-lens array is sandwiched between two inorganic dielectric substrates; and

a three-dimensional structure is formed on one of said two inorganic dielectric substrates.

Claim 16 (withdrawn): The micro-lens array substrate as set forth in claim 15, wherein the lenses of said first micro-lens array, and said three-dimensional structure are disposed at the same pitch.

Claim 17 (withdrawn): The micro-lens array substrate as set forth in claim 15 or 16, wherein said three-dimensional structure is a second micro-lens array.

Claim 18 (withdrawn): The micro-lens array substrate as set forth in claim 17, wherein said second micro-lens array comprises: the inorganic dielectric substrates; and a layer of resin whose refractive index is different from that of the inorganic dielectric substrates.

Claim 19 (currently amended): A production method of a micro-lens array substrate comprising the steps of:

forming a first micro-lens array having a plurality of lenses;

applying a photosensitive resin on the first micro-lens array;

patterning the photosensitive resin by irradiation of ultraviolet light or visible light;

forming a three-dimensional structure using the patterned photosensitive resin as a mask;

said step of patterning the photosensitive resin being ~~carried out using~~a step of forming the photosensitive resin into a required shape by adjusting a distribution of exposure light in the photosensitive resin by use of a beam that has transmitted through the first micro-lens array.

Claim 20 (original): The production method of a micro-lens array substrate as set forth in claim 19, further comprising steps of:

forming on an inorganic dielectric substrate the first micro-lens array having the plurality of lenses;

pasting a middle substrate on the inorganic dielectric substrate with a predetermined resin in between;

polishing a surface of the middle substrate, opposite the inorganic dielectric substrate, so as to adjust a thickness of the middle substrate to a predetermined thickness; and

applying the photosensitive resin on the polished surface of the middle substrate, so as to form the three-dimensional structure.

Claim 21 (original): The production method of a micro-lens array substrate as set forth in claim 19 or 20, wherein the three-dimensional structure is a second micro-lens array.

Claim 22 (previously presented): The production method of a micro-lens array substrate as set forth in claim 20, wherein a focal plane of the first micro-lens array is set in a vicinity of the photosensitive resin formed on the middle substrate.

Claim 23 (currently amended): The production method of a micro-lens array substrate as set forth in claim 21, wherein:

the photosensitive resin formed on the middle substrate has a two-layer structure of a first photosensitive resin and a second photosensitive resin; and

said production method further comprises the steps of:

applying and curing a visible light curable resin or a ultraviolet curable resin as the first photosensitive resin on the middle substrate; and

applying a negative resist as the second photosensitive resin, and wherein: the second photosensitive resin is patterned into the second micro-lens array; and

the second micro-lens array is etched to transfer the pattern of the second micro-lens array to the ~~first micro-lens array~~first photosensitive resin.

Claim 24 (previously presented): The production method of a micro-lens array substrate as set forth in claim 21, wherein:

an ultraviolet curable resin is used as the photosensitive resin on said middle substrate; and

the second micro-lens array is formed by:

curing the ultraviolet curable resin by irradiation of the beam that has transmitted through the first micro-lens array; and

removing uncured portions of the ultraviolet curable resin with an organic solvent.

Claim 25 (currently amended): A production method of a three-dimensional structure comprising the steps of:

applying a photosensitive resin on an optical member;

patterning the photosensitive resin by irradiation of visible light or ultraviolet light;

forming a three-dimensional structure using the patterned photosensitive resin as a mask,

said step of patterning the photosensitive resin ~~uses~~ being a step of forming the photosensitive resin into a required shape by adjusting a distribution of exposure light in the photosensitive resin by use of a light beam that has transmitted through an optical element having condensing function.

Claim 26 (original): The production method of a three-dimensional structure as set forth in claim 25, wherein said optical element having condensing function is formed or fixed on said optical member.

Claim 27 (original): The production method of a three-dimensional structure as set forth in claim 25 or 26, wherein a plurality of said optical elements having condensing function are provided.

Claim 28 (previously presented): The production method of a three-dimensional structure as set forth in claims 25 or 26, wherein:

said optical element having condensing function is irradiated with a parallel ray having a uniform intensity distribution; and patterning of the three-dimensional structure is carried out by tilting the optical member with respect to an optical axis of the parallel ray.

Claim 29 (original): The production method of a three-dimensional structure as set forth in claim 28, wherein the three-dimensional structure is patterned by:

adjusting a tilt angle of the optical member; and

adjusting intensity or irradiation time of the irradiated parallel light.

Claim 30 (previously presented): The production method of a three-dimensional structure as set forth in claims 25 or 26, wherein:

patterning of the three-dimensional structure is carried out using an irradiated light image formed by irradiation of the optical element having condensing function with irradiated light whose intensity distribution has been determined by a transmittance modulation mask whose transmittance is continuously modulated.

REMARKS

Applicants appreciate the notification of allowable subject matter, i.e., that claims 8, 12, and 30 would be allowable if rewritten in independent form, and to overcome any rejections under 35 USC 112.

Claims 1-30 are pending in the application. Claims 1-4 and 13-18 were withdrawn from consideration as being directed to non-elected subject matter. Independent claims 5, 19, and 25 have been amended to further define the step of "patterning the photosensitive resin." Claims 8 and 23 have been amended to overcome the rejections under 35 USC 112, first paragraph. The amendments are fully supported by the application as originally filed.

Claim 8 was rejected under 35 USC 112, first paragraph, "as failing to comply with the enablement requirement." Claim 8 has been amended to replace "inorganic dielectric substrate" with "middle layer," and make claim 8 to depend from claim 6 or 7, in the manner recommended by the Examiner. It is believed that the amendment to claim 8 overcomes the rejection under 35 USC 112, first paragraph.

Claim 23 also was rejected under 35 USC 112, first paragraph. To overcome this rejection, claim 23 has been amended to replace "first micro-lens array" with "first photosensitive resin," as recommended by the Examiner. Withdrawal of the rejection under 35 USC 112, first paragraph is respectfully requested.

As amended, independent claims 5, 19, and 25 each recite that the step of patterning the photosensitive resin is "a step of forming the photosensitive resin into a required shape by adjusting a distribution of exposure light in the photosensitive resin" by using a beam transmitted through the first micro-lens array (see, e.g., claim 5).

Referring to FIG. 3(c) of the application, for example, a resist layer 42 is irradiated with ultraviolet light through a first micro-lens array 6 to form a three-dimensional structure (see

specification at page 21, lines 1-8). As described on page 21, lines 8-15 of the specification, the resist layer 42 can have any form "by adjusting the intensity distribution of the irradiated light." As shown in FIG. 3(d), the resist layer 42 is shaped into a lens pattern of a "second micro-lens array" (specification at page 21, lines 16-18). Then, referring to FIG. 3(e), the lens pattern engraved on the resist layer 42 is transferred to a silica glass sheet 24 by dry etching (see specification at page 21, lines 20-22).

As stated on page 31, lines 1-5 of the specification, in the above-described production method, "the intensity distribution of exposure light is adjusted so that the exposure is stronger around the center of the optical axes of the respective lenses on the first micro-lens array." In other words, the exposure is targeted to areas near the optical axes of the lenses, which enables lenses to be easily formed into shapes according to the intensity distribution of exposure light (see, e.g., specification at page 32, lines 8-19).

According to the above claimed arrangement, it is possible to carry out patterning of a second micro-lens array (or a three-dimensional structure) by using the first micro-lens array. Therefore, alignment of the optical axes of these two micro-lens arrays is unnecessary. Further, the Applicants' claimed invention can prevent "a lens-pitch misregistration and does not require optical-axis alignment for the two micro-lens arrays" (see specification at page 35, line 20 to page 36, line 3).

Claims 5-7, 9-11, and 19-29 were rejected under 35 USC 102(a) or (b) as being anticipated by "Fabrication method of double micro lens array substrate" to Fujita et al. ("Fujita") or "31a-W-11 Fabrication of double micro lens arrays using a self-alignment exposure method" to Okada et al. ("Okada"). Claims 19 and 25-27 were rejected under 35 USC 102(e) as being anticipated by U.S. Patent 6,594,079 to Trott et al. ("Trott"). These rejections are respectfully traversed.

The Fujita and Okada references are not prior art to the application. The Fujita reference was published on **August 30, 2003**. The Okada reference was published on **October 1, 2003**.

The subject application is an application filed under 35 USC 371 with a filing date of **March 14, 2003** (International Filing Date of PCT International Application No. PCT/JP03/03125). Therefore, the filing date of the application pre-dates the publication dates of the Fujita and Okada references, and these references do not constitute prior art.

Moreover, the Examiner has not satisfied the burden of establishing the publication dates of the Fujita and Okada references. See MPEP 706.02(a): "The examiner must determine the issue or publication date of the reference so that a proper comparison between the application and reference dates can be made." Therefore, the rejection under 35 USC 102(a) or (b) over Fujita or Okada should be withdrawn.

Regarding the rejection of independent claims 5, 19, and 25 over Trott, the Trott reference does not teach or suggest a production method of a micro-lens array substrate or a three-dimensional structure in which a step of patterning a photosensitive resin is carried out by "forming the photosensitive resin into a required shape by adjusting a distribution of exposure light in the photosensitive resin" as claimed.

Trott is directed to "an image screen having an anti-reflective layer formed using the optical pattern of the screen itself" (column 2, lines 44-46 of Trott).

On pages 5-6, paragraph 5 of the Office Action of 01/24/2007, the "abstract and column 6, line 50 to column 8, line 4" of Trott were cited as allegedly corresponding to the Applicants' claimed invention.

Referring to FIGS. 6-11 of Trott, there is no teaching or suggestion of "forming the photosensitive resin into a required shape by adjusting a distribution of exposure light in the photosensitive resin" as claimed.

For at least the reasons discussed above, the Trott reference does not anticipate or otherwise render obvious the Applicants' claimed invention. Therefore, independent claims 5, 19, and 25 and their respective dependent claims are patentable over Trott.

It is believed that the claims are in condition for immediate allowance, which action is earnestly solicited.

Respectfully submitted,

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